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Commonwealth of Massachusetts

State forest service

STATE FORESTER'S OFFICE

PRACTICAL SUGGESTIONS

FOR THE

MASSACHUSETTS TREE PLANTER

BY

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ASSISTANT STATE FORESTER

SECOND EDITION



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CONTENTS

	PAGE
Introduction	5
Preparation and care of a forest nursery	6
Treatment in the nursery of the more important trees	10
Planting the seedlings in their permanent locations	12
Discussion of the best species to plant	15
Protection from fire	17
The cost of forest planting	18
The returns to be expected from plantations	19

Appendix: Diagram to scale of a small nursery; with a statement of its capacity for white pine, chestnut, red oak, white ash, and sugar maple seedlings	23
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PRACTICAL SUGGESTIONS FOR THE MASSACHUSETTS TREE PLANTER

INTRODUCTION

Just how many acres of land, capable of supporting forest growth, are lying idle throughout the Commonwealth, it is impossible at this moment to state. But to those who have considered the subject, it is apparent that thousands upon thousands of acres of such land exist. Almost every farm has some poor land, which will bring in greater returns when planted with trees, than when used for any other purpose. Land owners in increasing numbers are beginning to realize this fact, that much of the cleared land in this Commonwealth is best capable of producing forest crops. Approximately, half the State is already forested; and undoubtedly the care and improvement of these existing forests is of greater importance, than the planting of bare areas. But circumstances in individual cases often reverse this relation, bringing it about, that forest planting becomes the line along which many landowners can best work, in practicing forestry, and in developing the latent resources of their land. To emphasize this fact and to provide information, sufficient to answer many of the numerous questions which are continually being received by the state forester relative to the planting of forest trees, is the purpose of these pages. No claim to originality is made as regards the subject matter, which is mainly a compilation of facts already well known by forest tree planters; nor have all phases of forest planting been considered.

The method pursued in treating the subject has been to select the five species of trees which are best adapted for planting in Massachusetts, and to confine the discussion of forest planting entirely to these five trees.

These species are :

White pine	<i>Pinus strobus</i>
Chestnut	<i>Castanea dentata.</i>
Red oak	<i>Quercus rubra.</i>
White ash	<i>Frazinus americana.</i>
Sugar maple	<i>Acer saccharum.</i>

It should be stated that the greater part of what is said about white pine will also hold true of other conifers. In like manner, chestnut and red oak will serve as examples of the nut-bearing hardwoods ; while the treatment advised for sugar maple and white ash is very similar to that required by most other species of hardwoods. If, however, information is desired concerning the treatment of any species not specifically mentioned, it can be obtained on application to the state forester. Bulletins No. 29 and No. 45, entitled "The Forest Nursery" and "The Planting of White Pine in New England", issued by the U. S. Forest Service also give valuable information in regard to many points not treated here in detail.

PREPARATION AND CARE OF A FOREST NURSERY

The first step toward the establishment of a successful forest nursery is the selection of a suitable location on a level or gently sloping piece of land. Northern and eastern exposures furnish more favorable situations than southern and western aspects, and the soil, which may be loamy or even slightly sandy, should be well drained but yet contain a fair supply of moisture. If the nursery can be located within or near a forest, or in the shelter of a windbreak, it will be advantageous to choose such a situation.

The preparation of the soil should be the same as for an ordinary garden. While forest tree seedlings will often grow on poorly prepared land, yet any extra time and labor spent in carefully working over and pulverizing the soil will be amply repaid by the increased thrift of the seedlings.

When the soil is thoroughly prepared, the nursery should be laid out in beds and paths. The usual width for nursery beds is four feet, for beds wider than this are hard to weed.

The size of the nursery is the only limit to the length of the beds, and they may conveniently be several hundred feet long. Between the beds two-and-a-half to three feet should be left for paths, which should lie three to four inches below the surface of the beds. The actual construction of the beds is similar in all ways to that of a garden bed.

The preliminary preparation of the soil can be done either in the fall or in the spring, though it is often advisable to have the land at least plowed in the fall; but the making up of the beds should not be done until spring. As soon as the beds and paths are in shape, the nursery is ready for sowing. This process is discussed farther on in detail for the several species, and need not be considered here.

Each bed after being sown should be gone over with a small roller, or else have the soil firmed with a board or a hoe. Ordinarily the seeds of forest trees germinate and start to develop within the forest, and usually under a cover of leaf litter or duff. For this reason in the forest nursery it is necessary to approximate the conditions found in nature and to furnish the seeds with a protecting cover, which, by preventing rapid evaporation will conserve the soil moisture indispensable for their germination. A mulch of leaves or straw is customarily used for this purpose. This mulch should be thickly spread over the beds, soon after they are planted, and allowed to remain until the seedlings appear. It is important that the beds be frequently examined during this period, and the mulch be removed as soon as the seedlings break through the soil; or the shoots will be dwarfed, perhaps smothered completely. After the mulch is removed and the seedlings well started the beds will require weeding at more or less frequent intervals. Where the young plants stand too thickly they must be thinned out. It may very likely happen, that the seedlings will need watering during the course of the summer, for, while tree seedlings are not so greedy in their demands for moisture as many herbaceous plants, yet in dry spells they should be watered. With this contingency in view, it is always well to locate the nursery within reach of a supply of water.

On the approach of winter the beds should be covered

again with straw or leaves, since if left unprotected, the seedlings may be killed by the cold or heaved from the ground by the frost. In the spring of course the covering is removed.

COLLECTION AND STORAGE OF FOREST TREE SEEDS

(a) *White Pine*

White pine is an intermittent seed-bearer, the same tree yielding a full crop of seeds on the average only once in every three to five years. The bearing years vary locally to some extent, so that a crop may be produced in one section even though entirely lacking in others. Because of their infrequency it is well to look up a seed year in advance. As the cones appear on a white pine tree more than a year before the seed is ripe, the collector can easily tell, a long time in advance, when a seed year is due and lay his plans accordingly.

White pine cones open about the 15th of September in this State, allowing the two winged-seeds at the base of each scale to be shaken out by the lightest breeze. Unless the cones are gathered before they open, a very small proportion of the seeds can be secured. The collector should, therefore, pick the cones during the last week of August or the first week of September.

After collection, the green cones must be allowed to dry and open. They can be spread in thin layers on papers on an attic floor; or dried in some similar manner. But where large quantities of cones are collected shallow trays with woven-wire bottoms, or a lattice work frame can be economically used. The cones placed on these trays open when dry, and the seeds fall through the bottom into receptacles placed to receive them. To shake out any seeds which do not drop out of themselves, the cones should be beaten. As a final step, the seeds must be cleansed from dirt and impurities by being run through a fanning mill. The clean seed should then be placed in paper sacks and hung up in a dry, cold place, in a barn or shed, for instance, and left there till the time for planting in the spring. Frequently it will pay the planter to buy seed rather than go to the trouble of collect-

ing it himself. White pine seed varies in price from \$1.50 to \$4.00 a pound, according to the supply available. There are over 28,000 seeds in a pound of white pine seed; and the planter may expect to raise on the average about 10,000 seedlings from a pound of seed.

(b) *Chestnut*

Chestnuts may be gathered any time in the fall after the burrs open. Until the middle of November, the nuts should be spread out in shallow piles, where they will not become heated. When possible, place them on a dry dirt floor. From time to time they should be examined and, if found to be moulding, the piles should be spread out more; if the nuts appear to be drying out and shrinking in size, place them in a cooler place on the ground. Before the ground freezes, the nuts must be taken up and placed out of doors for the winter in a shallow pit. For this purpose, select a well-drained spot and dig a trench from three inches to a foot deep, depending on the quantity of nuts to be stored. Place the nuts in this pit, in layers two or three inches thick and separate the layers by an inch or two of sand. If pure sand cannot be obtained, layers of leaf litter will answer the purpose equally well. Over the top put on a cover of sand or earth to the depth of six to twelve inches. Beyond occasional inspection of the pile to see that no animals are digging in to get at the nuts, no more work is needed until the nuts are dug up to be planted.

(c) *Red Oak*

Red oak acorns are ready to gather in September and October. The directions for gathering and storing chestnuts will apply also to red oak acorns.

(d) *White Ash*

The seed of white ash should be collected in October and may be stored for a few weeks in a dry but cool place. But by the middle of November, the seed should be buried six inches or a foot under ground, for the winter, in a well-

drained situation. Owing to the smallness of the seeds, they are most easily handled when enclosed in strong cloth bags. These bags, when placed in the ground, should be surrounded by sand or leaf litter with a thick layer of earth over all, and left underground until spring.

(e) *Sugar Maple*

Sugar maple seeds should be collected in October, and cared for in the manner advised for seeds of the white ash.

TREATMENT IN THE NURSERY OF THE MORE IMPORTANT
TREES

The best time to plant the seeds is in the spring. This applies to all the trees considered. As soon as the ground is dry enough to work, the seed beds can be made up and the seeds planted; but no planting should be done when the soil is either excessively wet or very dry.

A general rule, in planting forest tree seeds, is to cover them with dirt from two to three times the thickness of the seed.

(a) *White Pine*

White pine seed can either be sown broadcast over the bed, or it may be sown in drills. As it is very difficult in sowing broadcast to secure an even distribution of seed, the method of drills is to be preferred. Moreover, the seedlings grown in rows are more uniform in size and usually stronger than those raised from broadcast sowing. The drills may be from six to twelve inches apart, while the individual seeds in each drill should be spaced, on the average, not more than three to an inch.

White pine seedlings, in common with those of other conifers, require partial protection from the sun during the first few years of their life. In nature, the proper amount of shading is furnished by the larger trees and by the ground cover. In the nursery, screens of lath are customarily employed to give the necessary protection.

The screens may be made by nailing laths on a frame four feet wide and of any convenient length. Between each lath

an open space should be left, equal to the width of a lath; so that the completed screen affords a half shade. To raise the screens above the plants, posts are required. They should be long enough to keep the screens about eighteen inches from the surface of the beds. Screens set on posts high enough to permit a man to work beneath them can be used if desired. If this is done some protection on the sides exposed to the sun should be afforded the seedlings.

As soon as the seedlings appear above ground, the screens are placed over the beds on the posts and removed only on cloudy days, after very wet weather, when it is desired that the beds be dried out. In the fall, when the seedlings are mulched, the screens may be laid on the beds to hold down the mulch.

White pine seedlings should be protected by screens, during their first two summers in the nursery. If they are allowed to remain a third summer in the beds, no shading will be required.

Ordinarily, in the spring of the third year, the seedlings can safely be taken up and set out in their permanent location. If they were kept longer in the nursery, the greater part of them would have to be transplanted and given more room. This largely increases the expense of raising the stock, making it advisable in establishing commercial plantations to take the plants from the nursery when only two years old. Until the seedlings have attained that age, they usually do not need to be transplanted. In some cases, if the plants should come up too thickly in the rows, some of them might have to be transplanted when one year old. This would not be necessary, unless they stood closer than an inch apart.

The chief enemy of white pine seedlings is a fungous disease known as "damping off." It attacks the seedlings when they are only a week or two old and is to be feared in wet, muggy weather. The disease shows itself in a wilting of the young plant. To prevent its occurrence, the nursery beds should be well drained and no water allowed to stand around them. "Damping off" does not attack the seedlings of broadleaved trees so frequently as those of conifers.

(b) *Chestnut and Red Oak*

Chestnuts and red oak acorns, when taken up from their winter storage, should be looked over and the bad ones removed. These cannot always be distinguished from good ones but a large percentage of the bad ones can be detected at this time. The nuts and acorns may be planted in rows about a foot apart and one to two inches apart in the rows. No protection from the sun, such as that afforded white pine seedlings, is required for chestnut and red oak.

Their seedlings grow rapidly and are ready for planting at the end of one year. At that time, they are anywhere from six to eighteen inches high and make excellent planting stock.

(c) *Sugar Maple and White Ash*

Sowing in drills a foot apart is recommended for white ash and sugar maple seeds. In these drills, the seeds should be strewn at the rate of four or five to the inch. On account of the wings attached to the seeds, they are hard to sow evenly. For these two species artificial shade is unnecessary, and the seedlings are of the proper size for planting after one year in the seed beds.

PLANTING THE SEEDLINGS IN THEIR PERMANENT LOCATIONS

Seedlings may be taken from the nursery beds and planted, either in the fall, or in the spring. Those planted in the fall are often heaved out of the ground by the frost, and are more easily injured by the winter storms than those set out in the spring. In most cases, the work should be done early in the spring, during the month of April or early in May. If possible cloudy, or even rainy weather, should be selected as the time to do the planting.

One of the most important things to remember in setting out seedlings is that their root systems must not be allowed to dry out during the process of removal from the nursery to the planting site. In order to make sure of this, the planter is advised to observe quite closely the following method of procedure.

First. Dig up in the seed beds all the seedlings that are to be planted, taking care not to bruise or break their root systems. The seedlings should never be pulled up.

Second. Have ready a tub or pail of water, thickened with loam or clay. As fast as the seedlings are dug up, tie them in bundles of 25 to 100 seedlings and dip the bundles into the muddy water, in order that the roots of the seedlings may become thoroughly coated with a film of mud. This is known as "puddling" and will hinder the drying out of the root system.

Third. Prepare a narrow trench 6 to 12 inches deep, cut down on a slant, and, just as soon as a bundle of seedlings has been puddled, place it in this trench with the roots down and cover it with earth, up nearly to the tops of the seedlings. When all the bundles have been "heeled in" in this way, they can safely be left (for several weeks if desired) until wanted for planting.

Fourth. If the nursery is close to the land to be planted, the bundles of seedlings can be taken from the trench as wanted. But the planting site may be several miles distant from the nursery. In this case the bundles of seedlings may be wrapped in sphagnum moss, rolled up in wet burlap, or packed in any way which will keep their roots moist, and taken to the planting site, where they should again be "heeled in" to be removed by the planter a few bundles at a time.

Fifth. When taken out to be planted, each bundle should be placed in a pail partly filled with mud and water, or in a basket filled with wet sphagnum moss. From the pail the seedlings may be taken one at a time and planted, thus insuring that the roots shall be wet when finally placed in the ground.

The actual work of planting can be accomplished handily by a crew of two men; one making holes for the plants with a few strokes of a mattock, and another who follows him with the plants setting them out. Another good way is for each man to plant seedlings in the holes he himself makes. The planter should take care to place around the roots of each seedling mineral soil comparatively free from leaves or rubbish of any kind, and to firm the soil down well; for no

air spaces must be allowed around the rootlets, or fatal drying will result.

The distance apart at which the seedlings are to be set out will vary somewhat with the objects sought from the plantation. A spacing of six feet apart each way is ordinarily the one to adopt for commercial plantations in Massachusetts; though where rough box lumber alone is desired a wider spacing may often be employed to advantage. When spaced 6 x 6 feet, 1210 plants are needed to stock one acre.

Once a year, during the first two or three years after its establishment, the plantation should be looked over and if large groups of seedlings have died they may be replaced by fresh plants. Beyond planting up blanks caused in this way the plantation, until it becomes ten to twenty years old, will require no care except protection from fire. For information as to the care of a plantation more than ten to twenty years of age, the reader is referred to Bulletin No. 2 of this office.

There are certain species of trees whose seeds can successfully be planted on the land where they are to remain permanently, thus doing away with much of the trouble and expense which is unavoidable when seedlings are bought or raised to be set out on the planting site. Of the species considered in this pamphlet, chestnut and red oak are such trees. Their nuts and acorns, instead of being sown in a seed bed, may be placed two in a hill on the land to be planted; the holes to be spaced 6 x 6 feet, just as though seedlings were being planted.

As the expense of establishing a plantation of chestnut or red oak is greatly lessened by planting the nuts or acorns instead of the seedlings, it is advised, that the former method be employed for these two species, whenever the proposed planting site is fairly clear of bushes and sprout growth. When the land is already covered with bushes or young sprouts, however, it will often be expedient to go to the greater expense of planting the seedlings.

The sowing of white pine seed broadcast, over a field or pasture, in the majority of cases results in failure to establish a satisfactory crop of seedlings. Even where seed spots

about a foot square are prepared and the seed is sown on these spots in contact with the mineral soil total failure may result; for, while cheaper than planting seedlings, it cannot be depended upon to give such good results as the latter.

DISCUSSION OF THE BEST SPECIES TO PLANT

In choosing the tree or trees to be planted, in each case, the principal things to be considered are these:

First. Whether the species is suited to the climate of the region where the planting is to be done.

An affirmative answer may be given to this query, if the tree already grows in the locality. But, on the other hand, the fact that the tree may not now grow in the region does not necessarily prove that it will not thrive when once introduced. In general it may be said that white pine, white ash, and sugar maple, may be planted in all parts of the State, except Barnstable, Dukes, and Nantucket counties. In these three counties there may be small areas where the above-named trees will thrive. Red oak has a somewhat more extensive range for planting as it will grow throughout the State, even in most sections of the three counties mentioned. Chestnut while having the same general range as these other species, prefers a somewhat warmer climate. For this reason, in certain localities in the extreme north-eastern and western portions of the State, chestnut should not be planted in cold or exposed situations.

Second. Whether the soil and moisture conditions are favorable for the growth of the species chosen.

For instance, even in a region well adapted to a certain species, the soil conditions over small areas may be such as to prevent its development. White pine will grow on soils of all sorts, the chief requirement being that the soil shall be well drained. The tree prefers gravelly sands with a clay subsoil which insures a supply of water not far from the surface. Swamps and low marshy land are not suitable places for planting white pine.

Chestnut also grows only on well drained soils of at least moderate fertility; otherwise its demands made upon the soil are not hard to satisfy. Red oak and sugar maple need a

deep fertile soil, with a fair amount of moisture, for their best development, and should be planted only on the better class of forest soils. White ash thrives on deep, moist, fertile soils, the moisture being the governing factor. White ash is adapted to planting in swampy situations, wholly unsuited to the other species mentioned. But it should never be planted in swamps where standing water remains for many months in the year. Notwithstanding its liking for wet locations, white ash grows well on the soils suited to the red oak and sugar maple.

Third. The character of the wood which the plantation will yield.

If several species can be successfully planted on a given tract, the product which the owner wishes to obtain from the plantation will usually determine the species to be chosen. In case fuel wood is desired, sugar maple or red oak will be the best trees to plant. White pine, of course, will lead as a producer of lumber and boxboards. For ties, poles, and posts, chestnut should be planted; while white ash furnishes valuable stock for wood working purposes. These few examples will serve to show that the nature of the future product should be considered before starting a plantation.

Another question which will arise is whether the plantation shall be made of only one species or shall be a mixture of several different species. White pine, chestnut, red oak, white ash, and sugar maple, may each be planted pure (*i.e.*, separately) or in mixtures, on situations adapted to the species composing the mixture. It will depend upon the wishes of the owner as to which kind of a forest is started. The chief advantage of a forest composed of only one species is that it can be more easily managed than one containing several species. A mixed forest, however, allows the owner to better adapt the product of his forest to the demands of the market, since he has several different kinds of wood to sell. The danger of bad fires and of ravages by insects and fungi is less in mixed than in pure forests.

In establishing a mixed plantation, the species may be mixed in several ways. The mixture can be by single trees, or by irregular shaped groups of the different species. Still

another desirable method is to have the species alternate by rows. But a discussion of the various possible arrangements cannot be taken up here; and anyone wishing further information for a specific case is advised to communicate with the state forester.

PROTECTION FROM FIRE

Of all the dangers to which a forest plantation is exposed, fire is the greatest. Insects, fungi, and natural factors, — such as storms and droughts, — frequently occasion losses among the young plants. But the damage done usually extends over only a small portion of the area planted and can be repaired at comparatively little expense.

A forest fire, however, if it once gains headway, may sweep over the entire plantation, entailing a total loss. This fire hazard of course is greatest while the plants are young, but is present in decreasing amount throughout the life of the forest. Every landowner, before establishing a plantation, should seriously consider the problem of fire protection. If protection can be secured at a reasonable cost, the plantation may be established; but if protection from fire can be obtained only through large expenditures, the idea of planting should be abandoned.

As a matter of fact, fire protection in a majority of cases can be secured very cheaply, when once the attempt to do so is made.

Efforts to protect a plantation from fire must vary in individual cases, but will be along two main lines, as follows:

- (a) Toward the construction of fire lines.
- (b) Toward patrol of the plantation.

By a fire line is meant a narrow strip of land, a few feet wide, bordering the area to be protected, and kept clear of all inflammable material. A roadway or else a plowed strip make the best kind of fire lines. Where the ground cannot be ploughed, all dead branches and leaves should be removed and the fire line burned over occasionally to keep down the grass. The ordinary surface fire will not pass such a fire line, which can be constructed for \$10.00 a mile as the maximum cost.

Where the area to be protected is of considerable extent, it may be wise to have a man keep watch of, or patrol, the plantation during the dry seasons in each year. Unless the tract contains several hundred acres or more the cost of such a patrol would be excessive, where paid for outright. But small landowners are often so situated that they can keep watch of their plantations themselves, without great inconvenience, thus obtaining fire protection at small cost. When the owner has become convinced that he can secure adequate fire protection for his prospective forest plantation, and not until then, is he ready to think seriously of planting.

THE COST OF FOREST PLANTING

The expense of establishing a forest plantation falls under two heads:

- (a) The cost of the planting stock delivered on the ground.
- (b) The cost of actually setting out the plants.

(a) *The Cost of the Planting Stock*

There are several ways in which planting stock can be obtained. Seed may be gathered or purchased and the seedlings raised in a nursery by the planter; or the seedlings may be bought outright from a nursery. Wild seedlings may be dug up in the woods and planted. In the case of chestnut and red oak, the nuts and acorns can be directly planted, greatly lessening the amount expended for stock and also in planting it. Then, the cost of seed and seedlings varies with the different species, white pine being more expensive than the hardwoods. Moreover, prices of forest tree seeds and seedlings differ greatly from year to year. For these reasons, no attempt will here be made to give the exact cost of obtaining planting stock. It may safely be stated, however, that where seedlings are to be set out 6 x 6 feet apart, requiring 1210 plants per acre, the cost of obtaining planting stock will range from \$2.50 to \$6.00 per acre. The upper limit will be approached when nursery

stock is bought, especially where white pine is to be used. The outlay will approximate the lower figure, when the seedlings are gathered in the woods or raised in a nursery by the planter himself.

(b) The Cost of setting out the Plants

The price of labor and the nature of the land to be planted, will largely determine the expense under this head. On very rocky land, or fields thickly covered with vines and brush, the cost of setting out the plants might easily run up to \$10.00 an acre. But on the average this work can be done for from \$3.00 to \$4.00 per acre, allowing 1210 plants to the acre.

The total cost then of establishing a forest plantation will, under average circumstances, vary from \$5.50 to \$10.00 per acre. Where the planter does a large part of the work himself, instead of buying material and hiring labor, the actual outlay in money may be reduced below the minimum amount given.

THE RETURNS TO BE EXPECTED FROM PLANTATIONS

Forest planting, like most other forest operations, requires the investment of money to yield returns only at the end of several decades. Before thus tying up their money, it is natural that landowners should desire to learn the returns which they may reasonably expect from plantations of forest trees. In attempting to estimate the returns, the total amount of the investment must first be ascertained. This is made up of several items.

1. The cost of the planting.
2. The value of the land.
3. The annual taxes.
4. The cost of fire protection.

All four should be figured with compound interest until the crop is harvested.

To show what these items amount to at the end of a definite period (40 years), the following table has been computed, for land of three different values, and for three dif-

ferent planting costs. Taxes were reckoned at 2%, and all calculations were made with 4% compound interest. The table gives the entire investment per acre, at the end of 40 years, which a man would incur in establishing a plantation; except that the cost of fire protection has not been included. This is a factor which cannot be computed except in each individual case. But for the purpose of this discussion, we may safely assume that it will never, at the end of 40 years, have accumulated beyond a maximum of \$10.00 an acre. So to the total figures in Table I. should be added in each case \$10.00. They will then show the total investment per acre in the plantation.

After adding the fire protection cost, these figures as can be seen range from \$44.51 on cheap land, with a low planting cost, to \$192.04 on land worth \$20.00 an acre, and where the cost of planting is \$10.00.

TABLE I. — *Investment per Acre at the End of Forty Years*

Land valued at		EXPENSES FOR PLANTING		
		\$3.00	\$5.00	\$10.00
\$3 00	Capital and interest . . .	\$28 81	\$38 41	\$62 41
	Taxes	5 70	5 70	5 70
	Total	\$34 51	\$44 11	\$68 11
\$5 00	Capital and interest . . .	\$38 41	\$48 01	\$72 02
	Taxes	9 50	9 50	9 50
	Total	\$47 91	\$57 51	\$81 52
\$10 00	Capital and interest . . .	\$62 41	\$72 02	\$96 02
	Taxes	19 01	19 01	19 01
	Total	\$81 42	\$91 03	\$115 03
\$20 00	Capital and interest . . .	\$110 42	\$120 03	\$144 03
	Taxes	38 01	38 01	38 01
	Total	\$148 43	\$158 04	\$182 04

So much for the amount expended. Now the question arises as to whether the value of the merchantable crop, at the end of 40 years, will be equal to the investment. In Table II. the returns per acre, at the end of 40 years, which may be expected from plantations of the five species considered, are given. If the values in any case seem excessive, it should be remembered that the tendency of wood prices is ever to advance, and that 40 years hence the values now given (in many instances existing at the present moment) will be too low rather than too high.

TABLE II.—*Returns at the End of Forty Years*

Species	Character of the Product	Stumpage Value per Acre
White pine .	40,000 B.M. ft. @ \$5 00 per thousand.	\$200 00
White ash .	20,000 B.M. ft. @ \$12 00 per thousand.	240 00
Chestnut .	Ties, poles, and cordwood . .	150 00
Red oak .	40 cords of fuel wood . . .	¹ \$50 00 to 80 00
Sugar maple .	" " " " . . .	¹ 50 00 to 80 00

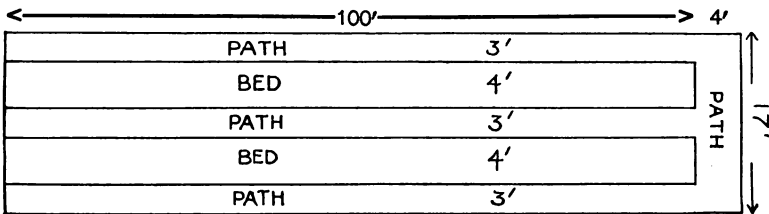
¹ The range in amount is due to the widely differing stumpage values of cordwood in the various parts of the State.

To the stumpage value per acre, given in Table II., must be added the value of the land (which can now be sold or used for other purposes) in order to arrive at the total returns from the plantation. Comparing the figures in Table I. with those of Table II., it is apparent that plantations of white pine and white ash will be profitable investments, yielding more than 4% compound interest for 40 years. Chestnut plantations will give similar returns, except where land is worth \$20.00 an acre and \$10.00 must be expended in planting it. But even in this case returns of practically 4% compound interest are insured.

Plantations of red oak and sugar maple are not so profitable, when cut at the age of 40 years, due largely to the fact that these trees cannot produce saw-lumber within that time. They should be allowed to grow a decade or two longer, when

APPENDIX

Diagram to scale of a small nursery ; with a statement of its capacity for white pine, chestnut, red oak, white ash and sugar maple seedlings.



A small nursery, similar to the diagram shown above, occupying only 104 x 17 feet of ground, would enable the landowner who intends to plant a considerable acreage to obtain first class planting stock very cheaply. The size of the nursery, of course, should be varied to fit each owner's needs.

As outlined above, the nursery contains two beds, one to be sown each spring, after the seedlings already in it have been removed, thus providing for a continuous supply. The yield which a single bed of the size described (100 x 4 feet) can furnish, will vary with the kind of seedlings it contains. Where white pine is raised, such a bed would have a capacity of 9600 seedlings, or enough to plant approximately 8 acres. To obtain this yield, the seedlings should be grown in rows 6 inches apart, with an inch between the plants as they stood in the rows. As already stated, white pine seedlings must be left in the nursery two years before they can be used for planting. So, for the first year after establishing a white pine nursery, there would be no yield ; but from the second year on, a steady annual output of 9600 seedlings could be obtained by sowing seed in one bed each year.

If chestnut, red oak, white ash, or sugar maple seedlings are raised, the output of a single bed will be 4800 plants, sufficient to plant 4 acres, or just half as many as in the case of white pine. The reason for this difference is that the hardwood seedlings are grown in rows one foot apart, while the white pine as previously stated should be in rows 6 inches apart. Since seedlings of hardwood trees may be planted when one year old, a regular annual yield can be secured from the nursery beginning with the end of the first year.

